Knowledge Constructing Through HyperMedia Authoring

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According to prominent learning theorists, learning is much more than gathering information in a well-designed, teacher-centered environment; learning is promoted when students pursue individual interests, when they build on prior knowledge, and when they engage in hands-on and authentic activity. Although a great deal of literature exists describing ideals such as these, research examining the implementation of these ideals in classrooms is scarce, and using technology for more than information giving is even scarcer. The purpose of this study was to examine a graduate course at a large, Midwestern university to discern how educational theory translates into classroom practice. In the course, students learned about educational theory by designing and creating a hypermedia chapter for a World Wide Web-based book. Qualitative data were collected across a 16-week semester and revealed both student and teacher perspectives regarding the course, including the strengths and limitations of a student-as-multimedia-author approach. The findings indicated that most all students were highly satisfied with the course, that some transferred learning, and that students developed skills and knowledge with instructional design, educational theory, and technology.

☐ Unfortunately, most courses are structured to transmit knowledge where adults have tight control over pedagogy by predetermining all or most learning objectives (Perkins, 1986). Then, adults construct meticulous lesson plans to deliver or impart fragmented content across several weeks or months. The idea of putting disciplines into bite-sized units that are to be taught through lectures across a series of weeks has a long tradition in American education, especially at secondary and postsecondary levels (see Gagné, 1985). Although methods such as lecturing, expository teaching, and direct instruction have their places in schooling, all too often, teachers adopt an information-giving approach and rarely consider alternatives (see Duffy & Jonassen, 1992). Some teachers supplement an information-giving approach with laboratory experiments, small group work, readings, or classroom activities. However, most of these supplements are designed to confirm teachers' predetermined curricula, goals, and answers (Kozma, Belzer, & Jaffe, 1993). Similarly, when teachers use technology, the technology is often used to supplement an information-giving or knowledge transmission approach—teachers use videos, animations, or reference software to deliver a preset curriculum or help students come to realize answers that teachers have already determined (Anglin, 1991; Becker, 1991; Lajoie & Derry, 1993; Newmann, 1996; Perkins, 1992).

Although it is difficult and challenging to find new ways of teaching and organizing information, for decades, educational researchers and theorists have suggested that pedagogy, including how teachers use technology, goes beyond merely information giving. Generally,

information-giving approaches fail to consider variations in student background knowledge, interests, goals, or learning styles. When teachers preestablish most learning objectives, including the sequence in which they will be learned, students are relegated to passive participants where they become overreliant on form and imposed structure and do not learn to self-regulate (Wood, Bruner, & Ross, 1976). Also, an information-giving methodology promotes a low-level understanding where students are unable to apply or use knowledge (Chi, Feltovich, & Glaser, 1981; Schmidt, 1993). Most importantly, there is scant evidence that an information-giving and hierarchical approach to learning works in school or university settings. Direct instruction or information giving appears to be successful for basic skills instruction, especially at elementary levels in reading and mathematics; for other subjects and other grade levels, however, there is "less of a basis for believing the direction instruction methods will improve student learning," (Slavin, 1994, p. 286).

Instead, many educational theorists, especially constructivists, believe that students enter classrooms curious about many things and have their own learning goals—goals that may or may not correspond to teacher-imposed agendas (Gardner, 1991; Piaget, 1970). Moreover, because each student enters a classroom with differences (in motivation, goals, background knowledge, experiences, aptitude, and attitude), constructivists believe it is next to impossible for information givers to create learning experiences that meet these variations (Fraser, 1988; Jonassen, 1991; Kaput, 1992). Instead, constructivists view learning as an active process that requires students to explore concepts under study or to learn through teacher-guided inquiry (Fosnot, 1989; Perkins, 1992). In fact, constructionists believe that learning is a process of becoming physically engaged with materials—to manipulate objects and build physical artifacts (representations) of understanding (Harel & Papert, 1991). Further, it is through the process of building or constructing an artifact that students come to know and understand the material under study (Harel, 1990; Hsu, Chappelle, & Thompson, 1993; Papert, 1980). *Learning by doing* and *learning through constructionism* are adages that represent this theory.

In short, constructionists believe that learning is an active process where students literally build or construct an understanding by creating personally meaningful artifacts (papers, documents, speeches, journals, etc.). Although the concept of knowledge construction has been a constant theme in education for years, contemporary researchers are now implementing and examining these ideas in classrooms. To illustrate, several have created knowledge-constructing learning environments where students learn by designing and developing multimedia artifacts (see Chou & Moretti, 1992; Harel 1990; Lehrer, 1993). In this approach, students learn a subject, such as biology, by designing and creating a multimedia document on a self-selected topic within biology. When this type of approach is adopted, technology becomes much more than an information-giving tool; it is thought to become a tool that promotes learning because students are using the technology to build and display an understanding about a topic. In other words, students learn the content under study by selecting a topic of interest, collecting information about that topic (in the form of videos, books, music, etc.), digitizing the information, and then organizing the information electronically. The goal of any student-as-multimedia-designer, multimedia-author is to encourage students to assemble their own information, to make their own connections and conclusions, and to put seemingly disparate pieces of information together holistically. The process of collecting information, organizing it, and then displaying it in a multimedia format allows the student to be an active agent in learning while physically building an artifact. Several have studied a student-as-multimedia-author and -designer approach.

One school's implementation of constructionism through multimedia design and authoring resulted in the development of a unique history course. At New York City's Dalton School, high school students learned American history by designing and developing multimedia documents on self-selected topics about the Civil War (Chou & Moretti, 1992). Within the context of a special research seminar, a self-

selected group of students learned by researching, designing, and authoring a multimedia presentation. Students worked in pairs across 16 weeks, conducting research at local libraries, museums, churches, and state offices. Students collected textbooks, pictures, video, and other media that reflected their understanding. After selecting media, they designed and created a presentation that exemplified their understanding. Once projects were completed, they became part of a repository that was used by other students at the school.

Harel (1990) was one of the first to conduct research on the theme of students-as-multimedia-authors. She conducted a study that examined the efficacy of using a software called Logo Writer as a knowledge-construction tool. Students in an experimental classroom used Logo Writer to learn principles of mathematics, namely fractions, by building multimedia documents that would teach others about fractions. Using two other classes as control groups, Harel found that the experimental group had a better understanding of mathematical concepts, mathematical problem-solving, and were more focused in their studies, especially when creating multimedia documents.

In another empirical investigation of students-as-multimedia-authors, Spoehr (1993) examined the efficacy of multimedia designing and authoring to promote the learning of American history. Her experiment took place at a high school with two different history classes: (a) one group of students was to learn history by creating and authoring a multimedia document; and (b) the other group was to learn history through a direct lecture format. Student-authors developed hypermedia projects that averaged 34 screens; however, several projects were twice that size. Most projects included 7 or 8 organizational screens that provided a summary. The projects averaged 51 hypertext links (most of the links were within the same document as opposed to linking to other student documents or to teacher-created documents). Comparisons were made between the student-authors and students in the regular history course across 14 measures, including the verbal and mathematics scores on the SAT, semester grades, and classroom assignments. There was a slight, but statistically nonsignificant advantage for the student-authors. Additional findings, however, showed that student-authors were significantly better at articulating and defending essay topics and included more information in their writing.

Lehrer (1993) also evaluated a students-as-multimedia-authors approach in a high school American history course. The 10 participants in this study were teacher selected, and included 4 females and 6 males; half of the students were considered successful and motivated and the other half were considered less successful and uninvolved in school. Students divided themselves into two groups where all of the high-achieving students worked together as one group, and all the lower-achieving students became a second collaborative group. Both groups created hypermedia presentations on the Civil War. Lehrer (1993) found a high degree of student involvement throughout the project where both groups became so involved that they volunteered additional time after school or on weekends. In terms of the final artifact, the team of successful students developed a more complex presentation that involved cross-topical relationships between media and ideas. In contrast, the less successful students' presentation was more hierarchical, essentially a progression from broad to narrow topics. Lehrer (1993) revisited 8 of the student designers one year later and found the experimental group of designers retained and was able to analyze history better than a group of regular history students.

Liu and Rutledge (1996) were interested in evaluating the influence of multimedia authoring on student motivation and instructional design. Their study sample included mostly minority students divided into one experimental group of 24 and one regular computer class of 22. The experimental class designed and created multimedia presentations for a local museum where students selected topics of individual interest (e.g., one group selected dinosaurs). The control group enrolled in a computer application class to learn word-processing, database management, spreadsheet programs, and desktop publishing. Data from the two groups were collected through questionnaires, direct observations, interviews, and an evaluation of

the student-created project or artifact. Researchers found that in qualitative and quantitative analyses, intrinsic motivation and self-efficacy (measured by field notes) increased for the experimental group. Task value scores, or the degree to which the students felt that learning a particular skill would lead to the development of the final product, increased for the experimental group and decreased for the control group.

Summary of Knowledge-Constructing and Multimedia Authoring

The goal of any student-as-multimedia-designer approach is to promote student learning by requiring students to assemble information, make connections and conclusions, and demonstrate an understanding by creating a comprehensive and multimedia artifact. Researchers who have used a students as designers-multimedia authors approach share common findings. Students seem to enjoy the flexibility of approaching subject matter in different ways; they become intrigued with expressing their thoughts, ideas, and conclusions using visual, written, and aural mediums. Likewise, initial research has provided some evidence that a student-as-author method encourages students to assume a greater responsibility for learning; prior researchers have documented that students become heavily invested in their projects, and on occasion, students spend entire weekends at school working on projects (Lehrer, 1993; Liu & Rutledge, 1996). Moreover, initial research indicates that students-as-authors learn about instructional design. Some have found that the method promotes learning.

Purpose & Rationale for the Study

The purpose of this study was to examine a graduate course at a large university to discern how a student-as-multimedia-author approach translated into classroom practice for graduate students. Several questions guided the procedures and their conceptualizations used in the study: What would students learn about authentic learning? What would students say they learned versus what their chapters-final artifacts would reveal about their learning? What would students learn about technology? How satisfied would students be within a student-as-author framework? What is the role of the teacher in such a course (e.g., how much time is spent on teacher lecturing or other forms of information giving, coaching students in student-directed research, teacher-to-student conferences, or teaching students how to use technology)? What are the strengths, challenges, and limitations to a student-as-author approach?

In the course, students learned about educational theory by designing and creating a hypermedia chapter for a World Wide Web-based book. Qualitative data were collected across one 16-week semester and revealed both student and the instructor's own perspectives regarding the course, including the strengths and limitations of a student-as-multimedia-author approach. The present study expanded prior research in several ways. For example, although researchers have found positive benefits of a student-as-author approach, most studies have used computer-based authoring environments where access to student-created projects was limited to local audiences. With increased availability, use, and interest in the Internet, however, student-created artifacts may be displayed and accessed on global levels. Accordingly, the present study broadens prior research because students designed and authored a Web-based document. Although featuring student work, such as art or writing, is not new to the Internet, in this study, the WWW was being used for more than displaying final projects created by students. It was being used as a knowledge-constructing tool (Jonassen, 1991).

Also, prior researchers have loosely documented student activity in a student-as-author environment; however, little is known about teacher activity in these classrooms. The present study extended prior research by examining the role of the instructor in such a classroom. Teacher activities were logged and summarized where a special consideration was devoted to documenting the time that the instructor—also

the first author of this paper—(and students) devoted to learning how to use technology, including learning authoring (Hyper Text Markup Language—HTML). Similarly, prior researchers have loosely documented student satisfaction with a student-as-author approach. Although prior researchers have found that students invest a great deal of personal time in creating multimedia artifacts, we don't know whether or not they like doing this. In other words, designing and creating multimedia artifacts is laborious—whether you enjoy the process or not. The present study further broadened prior research by examining student satisfaction with a student-as-author approach by asking students what they enjoyed (or did not enjoy) about the approach.

An additional unique feature of this study was its adoption of an action-research framework in which the researcher was also a participant in the study. Action research is a growing field of educational research where reflective inquiry into classroom instruction is the hallmark of the approach (Hopkins, 1985). Thus, action research becomes a useful way to report on classroom teaching activities, not only for the goal of improving individual teaching habits, but also with the hope of reporting findings of value to others. In action studies, all individuals involved are knowing and contributing participants; thus, from the onset, students are empowered and encouraged to express their thoughts and ideas freely and openly. The voice of the student is an important component in educational research, especially when examining alternative instructional approaches (Cooper & McIntyre, 1996). Students, better than anyone else, should be able to provide open and honest opinions, judgments, and suggestions about the strengths, as well as the limitations, for instructional innovations. For this study, student perceptions also helped to temper our own biases of presenting a course we designed and created in a solely positive light.

METHOD

Description of the Course and Facilitator

The study environment was an elective graduate seminar called Facilitating Authentic Learning. The course was worth three credits and met for three hours weekly for 16 weeks in a computer lab. The lab contained 18 computers, printers, scanners, a nonlinear video-editing system, Internet connections, and multimedia production software (for graphics, video digitization, HTML coding, etc.). Also, students had access to video and digital cameras. Enrolled in the course were 12 graduate students pursuing various degrees. The goal was for students to learn about the concept of authentic learning by designing and creating a chapter for an electronic "book" (this was the only task in the course). In other words, students were to develop an understanding of authentic learning by constructing a hypermedia chapter on a self-selected topic within that area. Students were informed that the book would be a compilation of all student chapters and would be placed on the WWW. Students were not expected to possess technology-related skills prior to enrolling in the course; instead, they would develop technological skills and an understanding of the concept of authentic learning by designing and creating their chapter. Students had the choice of working individually or in pairs; half elected to work in pairs. Students were informed about the study; all gave permission to use their formal and informal comments and final chapters for data in the study. They were told that it was a novel instructional approach—that the instructor had never previously used such an approach—and that their perspectives, both positive and negative, would be instrumental for understanding a student-as-author approach.

Along with having access to technology, students used course readings, minilectures, Internet search engines, and videos to collect information for their chapters. Soon after the introduction to the course, students selected topics. Most of each three-hour class was devoted to developing their chapters (collecting information, drafting written ideas, discussing ideas

with classmates or the instructor, digitizing media, or HTML coding). While students worked, the course instructor visited individuals or pairs to check progress, pose questions, offer resources, teach skills, or critique student work. The course instructor had a doctorate in educational psychology and had taught the course twice before, but not using a student-as-author approach. Instead, she had used a traditional graduate seminar format in which students conducted outside readings, and class time was used to discuss readings and related topics brought up by students. Two reasons why the instructor changed to a student-as-multimedia-author approach were (a) because she wanted to see how it could be implemented, and (b) she wanted students to learn about authentic learning by experiencing it.

Study Participants

Study participants were enrolled at a large university with a total student population of 20,000. Of the 12 who enrolled in the course, 9 were female and 3 male, 8 were Caucasian, 3 were Asian, and 1 was Hispanic; 9 were pursuing master's or specialist's degrees and 3 were pursuing doctorates; 9 were pursuing degrees in curriculum and instruction, and 3 in educational leadership; 6 of the study participants were working as teachers or principals at area schools; the other 6 were full-time graduate students. Informal conversations were held with all study participants during the 16 weeks; 5 students were selected for in-depth interviews at the end of the semester (described later in detail).

Research Design

The case study was qualitative and descriptive, using multiple data collection procedures (informal student conferences, anonymous end-of-the-year course evaluations, formal interviews, teachers log of activities, and an analysis of student chapters) to achieve that description. Case study data were compiled from 12 students who participated in the graduate seminar, and while a case-study approach provides a complex description of classroom contexts, a grounded-theory framework for synthesizing individual student cases into holistic interpretations was used (Merriam, 1988; Noblit & Hare, 1988; Rossman, 1993). The goal of the investigation was to make inferences and generate theory—to move from a theoretical view of what a student-as-multimedia author means to a more empirically driven, first-hand account of the method in practice.

Data Sources

Conversations during informal student-instructor conferences, an examination of each chapter (the final artifact), anonymous course evaluations, and a logging of teacher activities were collected by the first author. An end-of-the-year, formal interview was conducted by an independent researcher who was familiar with the study.

Informal student-instructor conferences. Conversations during informal student-instructor conferences were collected in a teacher's notebook beginning Week 4 and continued throughout the semester (there were no student-instructor conferences held during the first three weeks of the course). Informal student-instructor conferences typically revolved around student activities and these types of questions: What new information have you discovered on your topic? How does the new information fit into your preexisting ideas? What type of media will you use to support your conclusions? How will you collect or make it? What types of technical skills will you need to develop to include that media into your chapter? Are you having any difficulties, and if so, how may I help you?

Student comments that revealed insights to research questions were recorded by the instructor. In other words, if students revealed having learned something new about the concept of authentic learning ("Hey, did you know that Newmann has his research reports online and they report the benefits of authentic learning?") or having learned a new technological skill ("Wow, I can't believe I now know how to take this video and put it on the computer"), the comments were recorded. Also noted were their satisfactions ("I like the idea of putting my chapter

out for public inspection. It's a little scary, but personally gratifying. I worked hard on my chapter and feel proud of it") or dissatisfactions with a student-as-author framework ("I'm really spending way too much time trying to learn this code. Most of the other computers [in the computer lab] have different editing software, and I have to relearn it all over again"). If students commented on the strengths, challenges, and limitations of a student-as-author approach, these comments were recorded, too. Basically, when student comments provided insights into a student-as-author approach, the comments were noted. Most of the comments that were collected were done during the informal student-teacher conferences; however, there were several instances when students were interacting with each other and their conversations revealed their perceptions about a student-as-author approach, and these were recorded as well.

The final artifact. At the end of the course, student chapters were evaluated using a rubric, with a Likert-type scale for scoring (5 indicated the chapter really incorporated the element and 1 indicated the chapter did not at all incorporate the element). There were five global areas on the rubric: (a) Was the purpose of the chapter clearly articulated? (b) Did the author(s) cite research or related literature within the chapter to help support student claims and ideas? (c) Was the chapter organized and clearly written? (d) Did the media (pictures, links to other Web sites, graphs, audio, or video) support claims and ideas?; and (e) Did the chapter show creativity and originality (were there rich examples, solutions proposed, or future directions speculated)?

Students were made aware of the rubric at the beginning of the course, and the actual rubric was printed on the course syllabus. Students were aware that their rubric score would count toward their course grade. We scored the chapters using the rubric and obtained an interrater reliability of .87 (Pearson *r*). Data from student chapters were used to help answer these questions: What did students learn about authentic learning? What did their chapters-final artifacts reveal about their learning?

Course evaluations. Using a university-made questionnaire, anonymous student evaluations of the course were collected at the end of the semester. On this questionnaire, students used a Likert-type scale (5 was high; 1 was low) to answer 21 items (e.g., opportunity for practicing what was learned, instructor's preparedness, the course as a whole, etc). Appendix A contains this questionnaire and student responses. Along with the 21 items, students provided written responses to two questions on the questionnaire: (a) What changes could be made to improve the teaching or the content of this course? (b) What aspects of the teaching or content of this course do you feel were especially good? Data from the questionnaire were used to help answer these questions: How satisfied were students with a student-as-author framework? What were the strengths, challenges, and limitations to the approach?

Formal interview. Immediately after the semester was over, a nonprobability sample of five students was selected for a formal interview. Nonprobability sampling is used to solve qualitative problems; it involves selecting a sample that will assist investigators in learning or uncovering as much as possible (Merriam, 1988). To illustrate, five students who would likely offer diverse views of the course were selected, including males versus females, students who were working in the field as teachers or principals versus those who were full-time students, and students who appeared to be successful versus less successful. Of the five interviewees, two were male and three female, two were full-time students, three were teachers or principals, three were successful in the course (selected topics and supportive media easily and learned technology quickly), one was moderately successful, and the last one struggled in the course (she had difficulty selecting a topic, could not find supportive media, and labored with learning how to use technology).

To help students speak freely, the course instructor trained an independent researcher to conduct a semistructured interview (i.e., he was trained how to ask nonleading questions, to allow interviewees to diverge to other topics, and to use follow-up questions to clarify issues

brought up by the interviewee). At the onset of the interview, the interviewer told students that their responses would remain anonymous and that they should speak freely. Several questions were used in the interview: What were the daily activities? What did you learn ? How satisfied were you with the student-as-author approach? What did you see as the strengths of the course? What did you see as the limitations? The interview lasted between 30 and 45 minutes depending on what the interviewee wanted to say. All interviews were later transcribed for analysis. Data from the interviews were used to address many of the questions posed in the study.

Teacher's log. Teacher activities were logged into a notebook each three-hour period (Appendix B summarizes these activities). At roughly 15-minute intervals, the instructor recorded her activities in a narrative way ("I spent the last 10 minutes showing Karen how to link another Web site to her page and how to import a graphic). At the end of each three-hour period, the narratives were sorted according to time spent on: teacher lecturing or other forms of information giving, coaching students in student-directed research, teacher-to-student conferences, or teaching students how to learn technology. Information from the teacher's log provided data for this question: What is the role of the teacher in such a course?

Data Analysis

Student comments collected and recorded during informal student-teacher conferences and teacher-log activities were coded and analyzed repeatedly throughout the study by myself. Initially, open coding was used to categorize or label field notes and student comments (e.g., this field note suggests a weakness of a student-as-author approach; this comment suggests he has learned something new; this student comment suggests a strength, etc.). Along with open coding, axial coding was used to make connections between various data categories or to subdivide a category. To illustrate, many student comments or field notes were initially classified into one category: this would be considered a weakness of a student-as-author approach. As the study progressed, it became clear that the *this is a weakness* category needed to be subdivided: weaknesses owing to a lack of time to complete the project were grouped together, weaknesses associated with technology were grouped, and so on.

During the study, fresh (currently held) data were used to drive future informal conversations and logging activities. For example, if one student commented on a limitation to a student-as-author approach, the instructor conducted follow-up probes at the next class session, "Last week you said that you were having difficulty with designing your Web page so that others will understand it. What other types of difficulties are you encountering?" During this time, data were organized and reorganized around questions posed in the study. We created a matrix around the research questions where the instructor's notes and records of student comments were entered weekly. The matrix became useful for classifying or reclassifying data into the research question categories as well as for considering additional questions. For example, halfway through the study, we began wondering if students who entered the class with no or minimal technological skills made more comments regarding the weaknesses of a student-as-author approach than did those with skills. At the end of the study when all other data were collected (course evaluations, formal interviews, and final artifacts), these data were added to the matrix by myself. See Table 1 for an illustration of the matrix.

Miles and Huberman (1984) suggest several techniques for drawing reliable and accurate conclusions from qualitative data, including data triangulation—using data from multiple sources and multiple methods to draw inferences; collecting data from extreme cases—explicitly looking for negative evidence; and through reliability checking—sharing results with others familiar with the study. For this study, all of their suggestions were used: multiple data sources were used to draw inferences; unsuccessful students were deliberately sought out to provide unique perspectives on the course; and the research paper was shared with several individuals—two of whom were students in the class—to verify, clarify, or extend

Table 1 ☐ General Illustration of Data Matrix

	Student: 01	02	03	04	05	06	etc.
What did you learn about authentic learning?							
• learned the importance of authentic learning	×					×	
• learned about what it looks like		×		×	×	×	
• know how to implement it		×		×	×	×	×
• learned about the fallacy of standardized tests			×				
• learned how administrators may support teachers who want to implement authentic pedagogy	×					×	
• learned about the importance of cooperative learning		×			×		
• learned how to use portfolios to evaluate learning						×	
• learned about neurological processes involved in learning	×						
What did you learn about educational technology?							
• learned how to use PhotoShop		×	×			×	
• learned how to use a scanner		×		×			
• learned how to use a digital camera	×			×	×		
• learned how to format graphics for the web	×	×		×			
• learned how to use the web for research				×			
• learned how to HTML code	×	×		×	×		×
• learned how to use a video camera				×			
• learned how to digitize video	×	×	×		×		×
What were the strengths of the course?							
• could follow my own interests					×		
• learning was fun		×					×
• like expressing myself with video			×				×
• the tasks of designing and building pages was challenging	×	×			×		
• I liked that I learned by doing	×	×		×	×		
What were the weaknesses of the course?							
• I needed to be self-motivated	×		×	×			
• poor access to teacher	×						
• needed more time to complete my chapter	×		×				×
• needed to start HTML coding earlier	×						
• spent too much time tying to learn the technology	×						
• spent too little time learning the theory							
• struggling with technology that wasn't working					×		
• found course too challenging—too many things ongoing at once							

the findings and conclusions made in this study. Although some of the categories and questions in the matrix overlapped naturally, actual excerpts of student comments (from formal interviews, informal conversations, and course evaluations) and the instructor's perceptions are provided to explain and rationalize the findings.

FINDINGS

The final data set consisted of student comments from informal, student-instructor conferences; an examination of the final artifact; a formal interview; course evaluations; and a log of teacher activities. Several questions guided the study. The findings are organized around those questions. In most instances, excerpts are provided to explain and rationalize findings. The excerpts were selected from the master data matrix, represented comments made in that matrix category, and were deliberately taken from multiple data sources for triangulation (formal and informal interviews, written course evaluation comments, or from the teacher's log).

What did students learn about technology? Informal and formal conversations and course evalu-

ations indicated that all 12 of the students developed at least one new technological skill, where 9 of the 12 indicated and demonstrated many new skills. In fact, the reason we begin with this finding is that *most* of their informal, formal, and written comments concerned gratification with having acquired some sort of new technological skill. In other words, comments and actual demonstrations about having learned about the concept of authentic learning were completely secondary to having acquired a new technological skill. Although several reported having learned new declarative knowledge about technology (e.g., "Oh, now I know what HTML means and what the code looks like"), all reported having learned procedural skills ("I learned how to scan in here, how to use a digital camera, and how to HTML code"). The following excerpts represent comments made by students during informal conferences, formal interviews, and on course evaluations:

Hey look [name of another student], this is so neat . . . I learned how to do this in PhotoShop. Looks good huh.

It was an authentic reason for me to learn the Web because I had dabbled in it before but didn't have a real reason to do it. Because I had that authentic purpose [to create my own chapter for the book], then I was able to get into it and know why I was doing it and know that I had the support to help me get there.

I actually had to learn how to do Photoshop and learn how to take the images and redo them.

The biggest thing I learned had to do with the Web pages and the development, at least an attempt to develop the Web pages.

I can show you how to do that. I just learned how to create a table myself. I even found a Web site where you can type in a keyword and then copy-n-paste the HTML code directly into your file.

What did students learn about authentic learning? When individuals spoke of or were queried by the instructor about having learned something new in the course, about 35% of their comments centered on learning concepts important for facilitating authentic learning, as is indicated in the following excerpts.

I learned the value of authentic learning. I didn't come in as a proponent of authentic learning. In fact, [I was] somewhat opposed or at least not convinced of its value . . . I left not only thinking it worked but that it did have practical application in K–12 institutions.

I learned that teaching should be student-centered. I learned that learning should be project-driven and not textbook-driven. I learned a lot about how to organize a classroom. The class really changed the way that I looked and thought about teaching, and I have really tried to change the way I do things.

Teach by doing. Teach about authentic learning by doing it in the classroom. I saw that it functioned, and I saw I could extrapolate to a K through 12 institution and see that it could be done and that it was practical in that setting.

What I learned about authentic learning was that you took whatever it was that you were interested in and you applied it in a real situation. We were given a lot of latitude as to what we're going to study and do. Authentic learning, I think, is real and purposeful to you.

Naturally, most (about 65%) of their comments during informal teacher-student conferences centered on having learned something specific about their individual and specialized topics under study (e.g., "I learned how administrators may support teachers who want to implement authentic pedagogy; I learned a new fallacy regarding standardized tests; I learned how Gardner's theory of multiple intelligences applies to authentic learning. I just learned how the hippocampus influences memory"). Toward the end of the course, seven of the students suggested they were implementing skills and knowledge acquired in the course in other venues. Two began sharing the concept of authentic learning with colleagues (namely other teachers or principals), one began teaching the concept (e.g., she organized in-school seminars), and one began holding conversations with policy-makers at the state level. The following two excerpts represent data that we classified as *students were implementing skills and knowledge in other venues:*

I have tried to help other teachers implement authentic learning and technology into their classrooms.

I'm a little frustrated with learning about authentic learning. How am I able to let students follow their

own interests when I have specific learning objectives imposed on my classroom by the state? [This student went on to cite various school district assessment and curricular guidelines, which prevent teachers from experimenting with subject matter or pedagogy].

One of the teachers in the course went as far as adopting an authentic learning approach in her own classroom (while simultaneously enrolled in the course). Two others suggested they were earning wages for their newly acquired technical skills (of scanning, HTML editing, Web page designing, etc.) in research projects as is indicated in the following:

Hey Molly, you're not going to believe what I'm doing with my speech class . . . I'm having them write speeches to be broadcasted on [name of town's radio station]. . . . The kids are really psyched too; they get to pick out their own theme music and read their scripts on tape at the station. . . . Their friends get a kick out of hearing them on the radio.

It [The course] was just a starting point . . . I am now working on a Web page for the [name of research grant] project that I would not have done if I had not taken this class and gotten interested in it.

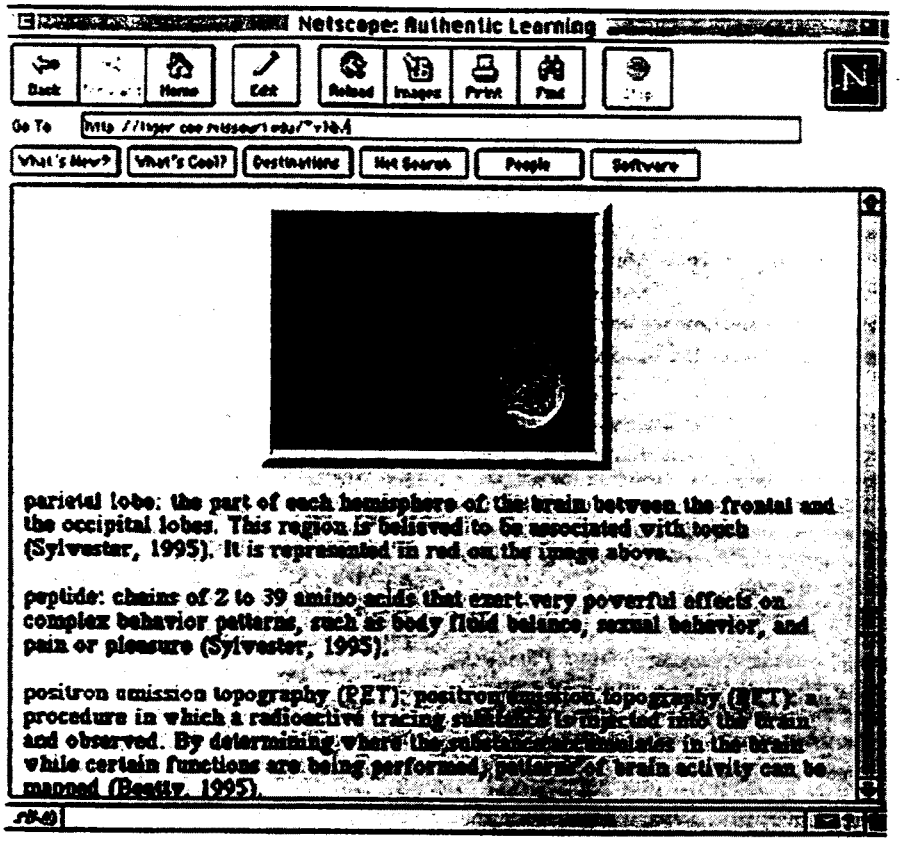
What did the chapters-final artifacts reveal? Of the 12 students, half elected to cowrite a chapter with a classmate; 1 of these pairs also wrote individual chapters. Chapter topics varied greatly; 2 elected general topics, including introducing the topic of authentic learning; 1 wrote on the importance of cooperative learning; 1 discussed how administrators may support authentic learning; 1 described neurophysiological substrates of learning; 3 students discussed how student learning and understanding could be documented; and 3 others, who were also classroom teachers, described examples of authentic classrooms.

Even though students said they had learned a great deal about authentic learning, many of the actual products (chapters) were modest at best. Only 3 of the chapters contained clearly stated purposes; 2 had partially articulated goals, and more than half either did not convey a purpose or contained one that was obtuse. Also, although all students cited relevant literature in an attempt to provide supporting evidence for claims made in the chapter, fewer than half were able to explain the research and integrate it meaningfully. Instead, the chapters became opinion pieces devoid of supportive evidence. Most (about 60%) chapters were so poorly organized, it was difficult to understand the intent, and many took on the appearance of a stream of consciousness where entire sections of prose appeared to have little connection to the intended purpose of the chapter or to surrounding ideas. Although 10 chapters contained relevant media (2 did not), the use of media was relatively unimaginative; 8 of the chapters resembled an academic textbook where pictures divided lengthy prose.

Moreover, direct observations and informal conversations revealed that four of the students held misconceptions about the concept under study. One student completely missed a primary goal of authentic learning by insisting that authentic learning could be implemented with teacher-centered direct lectures. According to this student, to teach authentically meant that teachers begin by lecturing students about authentic learning, defining terms, and then moderating discussions. Clearly, after having spent a semester in a course designed to teach about authentic learning theory, this student was unable to move beyond teacher-centered instruction. In another case, the student became so fascinated by the burdens faced by schools (violence, teen pregnancy, parental apathy), that she neglected to connect the issues with the concept of authentic learning. Another student had the goal of writing a chapter that centered on information-processing theory. His initial goal was to relate information processing to authentic learning. Instead, as Figure 1 demonstrates, his chapter took on the form of a dictionary where he simply provided definitions, albeit supported by pictures, of human information-processing mechanisms. Although he had access to rich Internet resources that could have become hypertext links in his chapter, he neglected to use them. In the end, he was unable use information processing theory to build a case for authentic pedagogy.

There were, however, six students who demonstrated an in-depth understanding of authentic learning (of the six, there were two pairs of students working on the same chapter). Figure 2

Figure 1 — Dictionary-like Presentation of Information



shows how one student used her chapter to describe how she (while simultaneously enrolled in the course) redesigned her Effective Speaking course around authentic learning ideals:

> My purpose for writing this chapter is to share my own experience in teaching an authentic activity in the confines of a traditional class . . . . In this chapter, I will describe the step-by-step process of designing, implementing and evaluating an authentic activity, as well as some of the obstacles which I encountered during the process.

In her chapter, she described how she began teaching her students principles of effective speaking by having students produce a radio broadcast at a local station.

In another case that demonstrated an elaborate understanding of authentic learning, two students worked together to create a chapter that dealt with evaluating student performance in authentic classrooms. This paragraph is the beginning of their chapter:

> Our research and study led us to two things: first, while the term authentic assessment is used widely today, it is commonly used to describe methods of assessment useful in a variety of learning practices . . . . Second, we found that many of the forms of authentic assessment (rubrics, portfolios, extended tasks, analytical trait scoring, etc.) developed under the broader definition of authentic assessment, still were applicable and viable assessment methods in the narrower context of authentic learning. Our chapter thus starts with the discussion of the difference between authentic assessment and assessment of authentic learning, moves to a discussion of methods used in authentic assessment, then to projects that incorporate authentic assessment, and ends with a discussion of terms related to authentic assessment.

Figure 2 □ Teacher implements authentic learning in own class

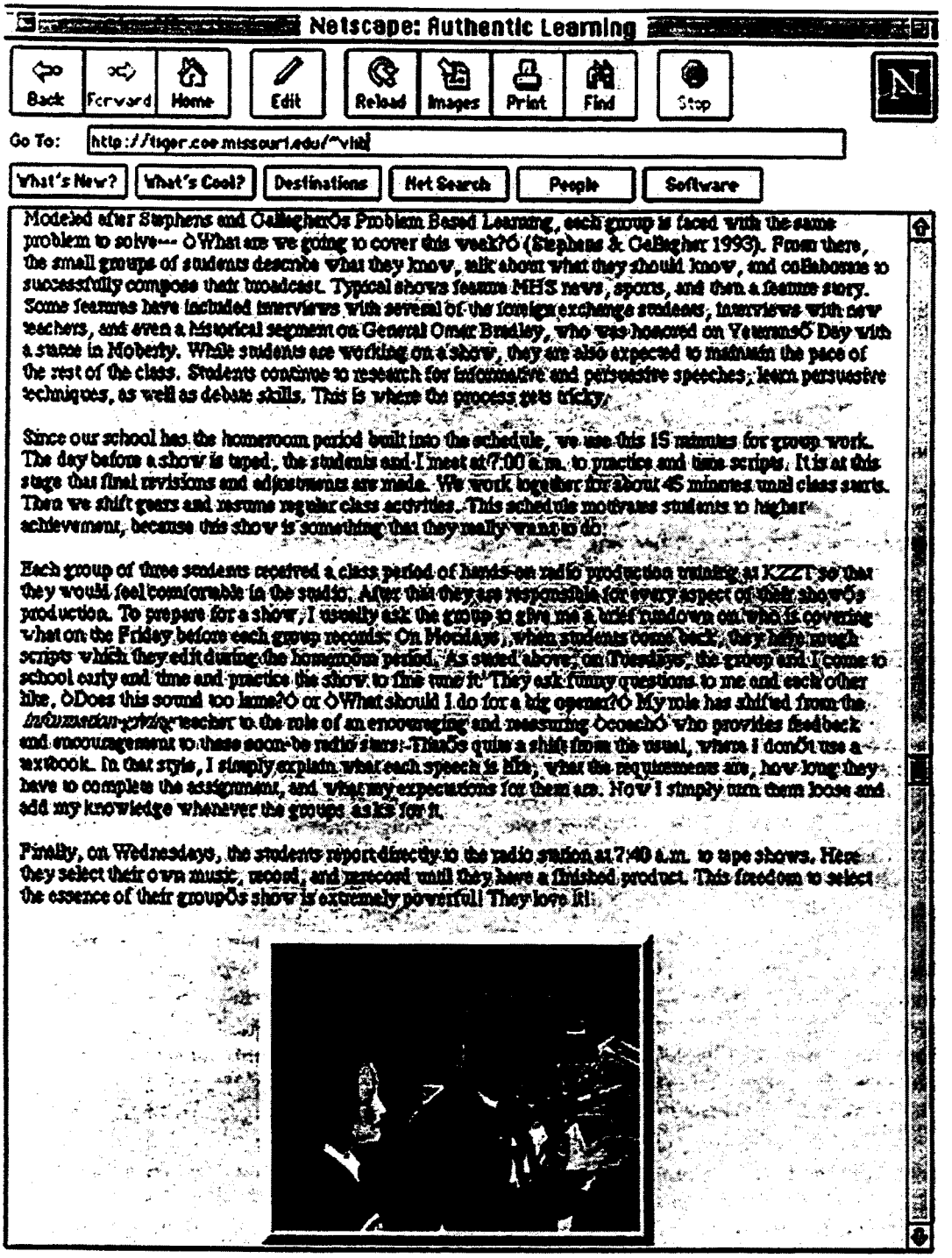
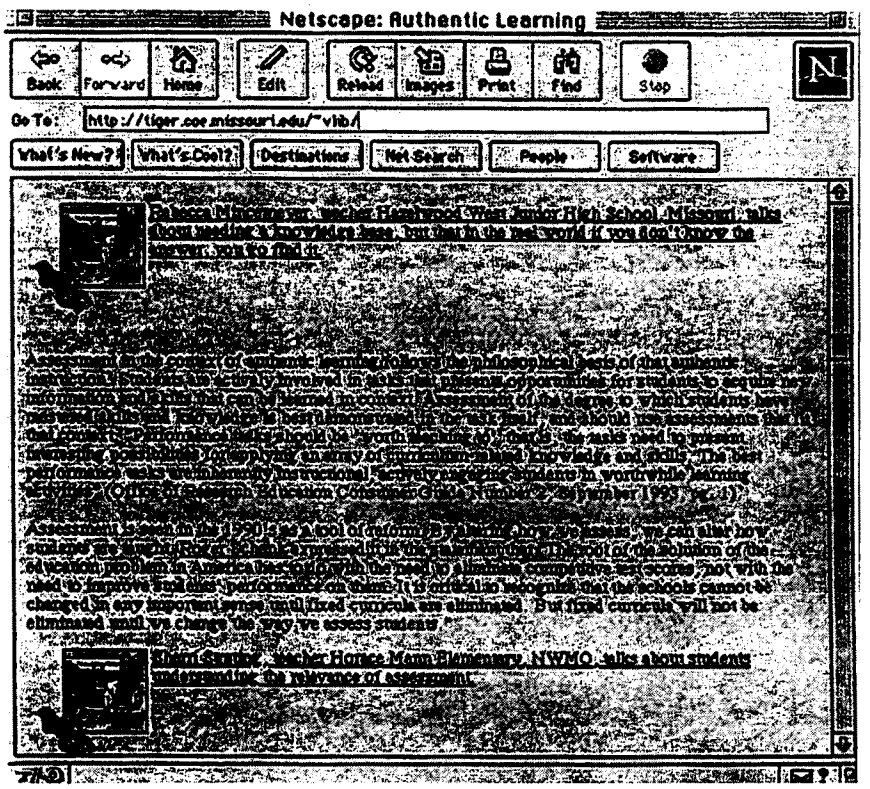


Figure 3 ☐ Videos, audios, and hypertext links



Their chapter contained videos that showed teachers using portfolios and audio files of teacher's comments regarding rubrics. They had multiple hypertext links to related Internet sites, including linking to electronic books, electronic glossaries of educational terms, and to research papers (see Figure 3).

What is the role of the teacher? One goal of the study included keeping track of instructor activities. Accordingly, the instructor logged each 3-hour class period. Table 2 summarizes the activities into several categories (Appendix B offers a more detailed account of the log).

Overall, 17% of the time was spent in activities where the instructor provided information to students, via large-group and direct lecture, on educational theory. For example, two hours were spent during the first class where the instructor lectured on the differences between information-giving and knowledge-construction approaches. Also, 6% of the time was spent in providing information to students, via large-group and direct lecture, on how to use certain technologies. For example, one hour was spent during Week 8 to lecture on the basics of HTML editing. About 12% of the time was spent helping students to collect information (videos, books, journal articles) that was specific to each student's chapter topic. The instructor spent about 19% of the time in teacher-student conferences where she helped individuals or pairs develop ideas. This included reading drafts of papers, asking students to clarify ideas, and asking students to identify media to support their conclusions. Another 33% of the time was spent in teacher-student conferences helping individuals or small groups develop technological skills. For example, on Week 11, the entire three hours were spent in assisting small groups of students digitizing media (pictures, movies, videos, etc.) and then altering the media digitally (e.g., teaching students the basics of PhotoShop to alter scanned pictures). The final two class periods (12% of the course) were devoted to students' sharing their final chapters during

Table 2 ☐ Instructor's Activity Log Summary

Information-Giving (of ed. theory)	*Information-Giving (about using technology*	*Assisting Students with Information-Collecting*	*Teacher-Student Conferences (regarding ed. theory)*	*Teacher-Student Conferences (regarding technology)*	*Students Sharing final products & course wrap-up*
Week 1: 2.5 hrs.	Week 3: 45 min.	Week 4: 3 hrs.	Week 6: 3 hrs.	Week 8: 2 hrs.	Week 15: 3 hrs.
Week 2: 3 hrs.	Week 8: 1 hr.	Week 5: 3 hrs.	Week 7: 3 hrs.	Week 9: 2 hrs.	Week 16: 2 hrs.
Week 3: 2 hrs.	Week 10: 1 hr.		Week 9: 1 hr.	Week 10: 2 hrs.	
			Week 12: 2 hrs.	Week 11: 3 hrs.	
				Week 12: 1 hr.	
				Week 13: 3 hrs.	
				Week 14: 3 hrs.	
Total: 8 hrs. (17%)	Total: ~3 hrs. (6%)	Total: 6 hrs. (12%)	Total: 9 hrs. (19%)	Total: 16 hrs. (33%)	Total: 5 hrs. (~12%)

informal presentations (the actual chapter was projected onto a large screen where individuals or pairs of students demonstrated and discussed their final product).

In summary, about 23% of the time during the semester was spent on large-group, information giving (on educational theory and on technology know-how); about 19% of the time was spent on coaching individuals or small groups of students in student-directed research; and 33% of the time was spent on helping individuals to develop technological skills they needed to create a multimedia and Web-based document.

What were the strengths and weaknesses? One weakness of the course included trying to accomplish too much in too little time. Students were required to learn educational theory, Web-page design, and Web-page construction simultaneously. Although 16 weeks may seem like a long time, five students indicated they desired more time to complete their chapters. The following two excerpts came from two different students who indicated they needed more time to complete their projects:

> The only part of the technical aspect of the course was the limitations of meeting once a week. It made it more difficult I think at least for (the instructor) to have 12 of us in there all asking questions. If the class had longer to meet, it may have been easier.

> The biggest limitation to me was finding the time to do as much research as I would have liked to have done because I teach elementary school all day long.

Another limitation included devoting too much time toward learning technology while not spending enough time toward learning about educational theory, namely authentic learning. After the first four weeks of the course, most students spent half of each class period learning new technologies. When the instructor mentored small groups or individuals, one third of the instructor's time was devoted to teaching students how to use technology. At one time or another, half of the students made direct comments about this issue, including the following:

> I don't think I learned as much about learning [theory] as I did about developing Web pages.

> I personally would have liked to have had some time built-in where we did some more focused learning as opposed to just working on our projects.

> The biggest [limitation] was the time factor . . . I expected to learn more about authentic leaning and authentic assessment because . . . the assessment issue is so difficult for people.

> Building a Web page and trying to learn all the jargon that goes with it is the hardest thing for me to understand because I am not into the computer language.

Although half of the students would rather have spent less time learning the technological mechanics associated with building a Web page, 10 made comments that indicated they willingly accepted this activity because they valued the learning opportunity it created. Many of their comments suggested that designing and creating the Web page were instrumental in their learning—the activity of designing and then creating a Web page compelled them to understand

individual topics to a greater extent, for example:

I think it was a great activity to learn about authentic learning. I think if we had just been lectured to or were just given a textbook, I don't think I would have learned as much as I did or become as interested in the topics as I have if the Web page wasn't a part of the class.

We were doing the page on multiple intelligences in cooperative learning, and so I did research on that and put it together. Then I learned how it all fit together on the Web page. I learned a lot about those areas because that's what I had to do in order to condense it enough to put it on the Web page.

I liked the latitude of being able to take the information that I had and figuring out "How am I going to put this together as a workable document on the Web page?"

I liked how [building a Web page] made me think about how I like information to be presented to me. And then what I learned most . . . was how to structure something so it could be used [by others].

You really had to know the information in order to do that [present it on a Web page]. If I would have just been asked to write a paper, I could have just written a paper and it wouldn't have taken me two or three hours. By having to do it this way, I really had to know that information, to know how to put it succinctly into a Web page.

From an instructor's perspective, one of the greatest difficulties rested with managing several project topics because it was difficult to remember the intricate nuances associated with each student's separate project, provide students with multiple resources on wide-ranging topics, and discern at what level students understood their topics so that student learning could be scaffolded. Even students recognized this difficulty, as is exemplified in the following comment:

It takes a great deal of [the instructor's] expertise, knowledge, time, enthusiasm, to keep everyone going because she is really teaching at two different levels: one is a technological level of Web page design and the next level up is authentic learning, and keeping both of those going I would think would be a trying teaching exercise.

Another difficulty was providing students with equal access to the instructor's time. While the instructor worked with an individual, others needed to wait for attention; on occasion, some waited for an hour. When waiting was excessive, students tried to help each other or became tired of waiting and began something new. Student comments included the following:

Sometimes [instructor's name] would spend the entire time teaching students how to use technology. Because I came into the course with many skills, it was hard to get access to her when I needed help developing or organizing my ideas. Even if she wasn't teaching someone how to use technology, it was hard to get a hold of her.

I'd suggest that the class size be limited to no more than 10 or smaller. It may be better for some that have more knowledge of computer skills to have the course if it continues to go on the Internet.

Another weakness of a student-as-multimedia-author approach included the issue of self-directed learning. Although most of the students were successful in monitoring and regulating their own learning, this wasn't the case for everyone in the study. Three individuals had extreme difficulty with the concept of self-directed and self-regulated learning; these individuals required much more support from the teacher, and their chapters were poorly developed. In one case, the individual did not possess enough self-regulating skills. Example comments on self-regulation were:

I'm really not sure if I'm doing this right at all. I go to the library, and I feel kind of lost. What should I be looking at? At first I was afraid that I wouldn't be able to find anything about my topic, and now I'm finding too much. I'm finding it hard to sift through all of that stuff—most of it's useless for me anyway.

I have absolutely no idea what I'm suppose to do. You tell me to pick my own topic and then you tell me to find something out about that. How am I suppose to do that? I don't get it at all. I mean, I know how to go to the library and all, but you're not asking us to write a term paper.

However, in the other two cases, problems with self-regulation appeared to be linked with poor motivation. It appeared that the course was requiring too much effort on their part and that they were trying to produce just enough to satisfy course requirements. Interestingly, there were two individuals who made a point to say that the self-directed learning style of the course was a positive distinction of the course:

The main thing I learned as far as authentic learning goes was to do the work on my own. By doing the work on my own, I had to come through and construct my own knowledge of what it was I wanted to do.

After figuring out what I had to do, I had to figure out my own methods of how to do it.

I would have to say the biggest support was for us to be able to learn about how to do something on our own, not just the research but getting along with others and trying to help each other out as much as we could.

How satisfied were students? Although both students and the course instructor found weaknesses in a student-as-multimedia-author approach, all students indicated high satisfaction with the experience, even the two who were not motivated. For the most part, they enjoyed the flexibility in approaching the subject matter under study. As reflected in the following excerpt, they reported a special enjoyment with being able to work individually or with others, selecting their own topics, and collecting diverse media:

[The course] was totally student-centered. I got to pick what I wrote about; I got to pick what I researched. I am just really sick of people saying "you will do this" and that grinds me, and I don't like it. So that was one of the best things about that program, the freedom. Whatever you want to do, was okay.

Likewise, many were intrigued with expressing their thoughts using visual, written, and aural mediums; several indicated during classroom observations that they had never before experienced a course where they were allowed to express their thinking and learning in a multitude of ways. Similarly, most commented on the open nature of the course and expressed a dissatisfaction with graduate courses where the vehicle of learning was mostly direct lecturing or small group discussion. Students liked the challenge of learning about educational theory, technology, and design simultaneously.

Anonymous student evaluations of the course revealed additional satisfactions with the course. On this form, students used a Likert-type scale (where 1 was low and 5 was high) to provide the instructor with information across many variables: opportunity for practicing what was learned, 4.9; instructor's preparedness, 4.6; the course as a whole, 4.5; explanations of underlying rationales, 4.6, and so on (again, see Appendix A for student responses on this form). Along with the 21 Likert items, students provided written responses to two questions, (a) What changes could be made to improve the teaching or the content of this course? and (b) What aspects of the teaching or content of this course do you feel were especially good?

Responding to the first question, four students indicated that no changes were needed, three students suggested that they spend more time in the computer lab, and three wanted the instructor to provide direct instruction on technology usage earlier. Question (b) responses included: two students indicated they experienced a lot of "fun" in the course; two indicated the instructor was available for help and encouraged students to pursue their own interests; and six indicated a high satisfaction with learning about educational theory by "doing" educational theory, as the following excerpt illustrates:

We learned about authentic learning by actually completing authentic tasks. Most classes just give theory and show no way to actually use it. We learned how authentic learning can be used because it was actually used on us.

Along with positive student evaluations of the course, one of the strongest indicators of student satisfaction occurred during the last week of the course. Students were asked to present publicly and describe their individual chapters to other classmates. Following this event, more than half the students printed several copies of their chapters. Students were assured that their work would be displayed for many semesters on the Web—therefore, printing copies was not necessary. At this time, students indicated the copies were meant for spouses, parents, or even grandparents who were not connected to the Internet. Clearly, students were proud of their work and wanted to share the finished product.

DISCUSSION

At the turn of the century, Dewey advocated learner-centered but teacher-guided education built around efforts to link purpose and structure. . . . He advocated projects like designing a clubhouse because this activity embraced multiple levels of organization and placed students in the role of developing rather than receiving knowledge. Unfortunately, schools rarely embrace this philosophy, in part because the metaphor

of learning in schools is often one of knowledge transmission rather than of knowledge construction. (Lehrer, 1993, p. 197)

An important concept that has returned to instructional theory is the concept of learning through construction. Nearly 100 years ago, Dewey advocated that students learn by building clubhouses. Ninety years later, students are learning by building multimedia artifacts, including Web pages. Although a great deal of literature exists describing the need for instructional design to evolve around knowledge-construction tasks, research examining this ideal in classrooms is scarce (Harel & Papert, 1991). The purpose of the present study was to examine a graduate course in a large university setting to discern how a knowledge-construction activity translated into classroom practice. In the study, students learned about educational theory, namely the concept of authentic learning, by designing and creating (constructing) a chapter for a Web-based book.

In spite of student reports of having learned a great deal about educational theory, in-class probes and an examination of the final artifact indicated that most students had only a modest understanding of the concept under study, while one third held astonishing misconceptions. The discrepancy between student reports versus our own observations may be explained in several ways. First, if learning is a process of building on what students already know, perhaps students entered the course knowing very little about the concept of authentic learning. Therefore, although we viewed student learning as modest, from the students' perspective, learning was significant. In a couple of cases, student learning was indeed significant.

When designing courses then, from a constructivist perspective, how important are teacher expectations and teacher agendas? Is it enough to design courses that satisfy goals of students, yet do not satisfy goals of instructors? According to Schank and Cleary (1994), the goal of the instructional designer is to create courses to help students achieve goals they have selected for themselves. However, most instructional designers would believe that a successfully designed course negotiates between the goals of students and those of course designers. To this end, how are constructivist teachers to create a student-driven curriculum when state or national standards impose mandates? Prior research indicates it is important to share decision-making with students (Cooper & McIntyre, 1996).

There may be another way to explain the discrepancy between the instructor's versus the students' view of what they learned. Perhaps the sheer novelty of and their genuine excitement toward the course led students to overestimate their learning. Numerous student comments indicated that this was the first time they were given latitude to follow their own interests and express their ideas in multiple ways. Likewise, many of them indicated that their chapters may be put to good use by others who read them, instead of sitting on a teacher's desk. The following comment was made during a teacher-student conference toward the end of the study:

You know what's cool about all of this is that I'm not creating a paper just for you. I mean, I've written dozens of term papers for my professors, and at the end of the course, I never look back. But this is different because I'm creating something that I think has real meaning—real meaning because it was a good way to get me to learn this stuff, and because there is the potential that someone will actually use my chapter for their own work.

Ultimately, remarks like these became a somber commentary regarding the nature of graduate school, in that students in this study viewed prior courses as fundamentally passive and without much purpose. To what degree are these views held by other students?

A more likely explanation of why students did not seem to learn a great deal about educational theory was that too much of each class period became devoted to learning how to use technology (to scan images, digitize video, or to write HTML code). This would not be problematic if the purpose of the course was to learn about educational technologies. In other words, multimedia production and Web-page construction compete with time that *should* be devoted to learning the content under study. How will the burden of having to learn complex technologies be lessened in a student-as-multimedia-author classroom?

Perhaps our perceptions regarding student learning were inaccurate, and students *did* learn much about educational theory, but they were unable to express or demonstrate their learning on a Web page. Certainly, simultaneously learning new content, how to use technology, and how to design an aesthetically pleasing and informative Web page are arduous tasks—even for adults. Their resulting chapters are good indicators of the difficulty associated with these interconnected activities; most of the chapters took on the appearance of a stream of consciousness, and their use of media was relatively unimaginative. Not only may students have had difficulty demonstrating their understanding on a Web page, assessing or evaluating such artifacts for student learning and understanding is difficult. Even though newer methods of assessment purportedly evaluate learning beyond the recitation of facts, this is easier said than done (Nicaise, 1996).

Part of the problem in documenting student learning in constructivist classrooms stems from the fact that students select their own topics of study. In this line, students appear to learn a lot about specialized topics, but learn much less about global issues associated with the concept under study. In the present study, students showed little interest in learning about topics other than their own. Their lack of learning about classmates' topics may be related to the supposition that the task of creating a multimedia chapter for the Web provided them with little time to do anything else, including learning about other areas, or maybe there was no interest or motivation to learn other topics (Glasgow, 1997). From a constructivist perspective, instructional designers should not be concerned with mandating the same knowledge for every student (Bednar, Cunningham, Duffy, & Perry, 1992). To manage a multitude of different topics, however, is a different story. The instructor in the present study had difficulty remembering the intricate nuances associated with each student's project. The idea that classroom learning needs to be entirely situated around student interests or project ideas may be an idealistic notion, at least for now. As such, future researchers need to thoughtfully examine and identify support systems that will help teachers to create, manage, and sustain a student-as-multimedia-designer approach (Cronin, 1993).

Moreover, future researchers need to identify support systems that will help students to succeed in a multimedia-author classroom (Nicaise & Barnes, 1996). Fitzgerald, Hardin, and Hollingsead (1997) found that students whose learning style preference was less structured and more creative, as opposed to students whose learning style focused on a need for organization, seem to fare better in a student-as-multimedia-designer classroom. This is not to say that only certain types of students belong in these environments, but that future research should identify support systems that will help all students to manage their own learning. If we can identify ways of helping students to view learning as an internally-regulated process as opposed to a process that is externally regulated by teachers, then student-centered courses will be easier on both teachers and students.

Despite the challenges of a student-as-multimedia-author approach, nearly all students reported enthusiastic satisfaction with designing and creating their own Web page. Using the Web as a tool for knowledge construction is valuable, and in this classroom, was rather effective from the students' point of view. Future research needs to continue to examine the importance in using technology as knowledge-constructing tools as opposed to using technology for knowledge dissemination. Likewise, future researchers should examine the impact of using the Internet as a knowledge-construction tool; in the present study, students were motivated to create a dynamic page because a global audience could view it. According to students, the potential of a global audience helped students to take their task seriously, where ownership over their projects went well beyond the extrinsic motivation of a grade, or instructor approval.

There are many high expectations regarding technology's role in facilitating learning. One expectation is that technology may help to create reflective students and pluralistic classrooms. Also, there is the hope that technologically-supported learning will enable learners to transfer knowledge and skills to novel and real-world situations. New technologies, like Web page

construction, may support learning in ways not achievable in the past, where students become engaged in meaningful learning instead of rote practice with discrete concepts (Fraser, 1988; Kaput, 1992; Perkins, 1992). Future research is needed to determine if these expected benefits will ever be realized. □

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Appendix A ☐ Anonymous End-of-the-Year Student Evaluation

	Percent Responding						
Section I—Diagnostic Feedback	*High 5*	*4*	*3*	*2*	*1 Low*	*# Resp.*	*Mean*
1. Opportunity for practicing what was learned	90.0	10.0	0.0	0.0	0.0	10	4.9
2. Instructor's preparedness	80.0	10.0	0.0	10.00	0.0	10	4.6
3. Explanations of underlying rationales	70.0	20.0	10.0	0.0	0.0	10	4.6
4. Demonstrations of expected skills	90.0	0.0	10.0	0.0	0.0	10	4.8
5. Instructor's confidence in student ability	100.0	0.0	0.0	0.0	0.0	10	5.0
6. Recognition of student progress by instructor	100.0	0.0	0.0	0.0	0.0	10	5.0
7. Student confidence in instructor's knowledge	80.0	10.0	10.0	0.0	0.0	10	4.7
8. Freedom for students to develop own skills	100.0	0.0	0.0	0.0	0.0	10	5.0
9. Instructor's effectiveness in dealing with difficulties	100.0	0.0	0.0	0.0	0.0	10	5.0
10. Atmosphere for student learning	90.0	10.0	0.0	0.0	0.0	10	4.9
11. Availability of extra help when needed	100.0	0.0	0.0	0.0	0.0	10	5.0

Section II—General Evaluation	*E*	*QG*	*S*	*F*	*P*	*# Resp.*	*Mean*
1. The course as a whole	60.0	30.0	10.0	0.0	0.0	10	4.5
2. The content of the course	70.0	10.0	20.0	0.0	0.0	10	4.5
3. The overall teaching effectiveness	70.0	10.0	20.0	0.0	0.0	10	4.5

Section III—Information for Other Students	*E*	*QG*	*S*	*F*	*P*	*# Resp.*	*Mean*
1. Use of class time	50.0	40.0	10.0	0.0	0.0	10	4.4
2. Instructor's interest in whether students learned	80.0	20.0	0.0	0.0	0.0	10	4.8
3. Amount you learned in the course	60.0	20.0	10.0	10.0	0.0	10	4.3
4. Relevance and usefulness of course content	70.0	20.0	10.0	0.0	0.0	10	4.6
5. Evaluative and grading techniques (tests, papers, projects)	88.9	11.1	0.0	0.0	0.0	9	4.9
6. Reasonableness of assigned work	80.0	10.0	10.0	0.0	0.0	10	4.7
7. Clarity of student responsibilities and requirements	80.0	20.0	0.0	0.0	0.0	10	4.8

Appendix B — Instructor's Summary Log of Activities

Week	
1	Introduced purpose of course (15 min); reviewed syllabus (10 min); students introduced themselves & reasons for taking the course (30 min); began lecture on differences between information-giving and knowledge-construction approaches (2 hours).
2	Continued lecture on the fundamental difference between authentic v. traditional classrooms (1 hour) showed CASA & PBS videos as illustrations of authentic pedagogy (45 min); facilitated all-group discussion of first two readings from reading packet (1 hour).
3	Continued lecture on the fundamental difference between authentic v. traditional classrooms, including Schank's top 10 mistakes schools make & Newmann's research at Wisconsin (1 hour); students shared their ideas for their chapter topics (1 hour); students began searching the Internet for helpful resources—six students needed direct instruction & close supervision with how to do this (45 min).
4 & 5	Students spent the next 2 class sessions collecting and reading resources; I spent all of my time meeting with individuals or small groups of students to discern what they found and offer suggestions for additional resources, including searching my own collection of articles, books, & videos, for students (6 hours).
6 & 7	Students spent the next 2 sessions organizing resources and drafting initial ideas into text; I spent all of my time reading drafts, asking students to clarify ideas, and began asking them to think about the types of media they could use to support their conclusions (6 hours).
8	On week 8, students were introduced, via direct lecture, to the basics of hyper text markup language (HTML) coding (2 of the 12 had prior experience in HTML coding, so they began developing their page at this point) (1 hour); students practiced using HTML coding by converting text files to HTML & I assisted in this [2 hours]; at the end of class, students exchanged their chapters with another; students were instructed to serve as a peer editor and bring the critique to the next class period.
9	This class session began with students sharing their peer editing comments; while students shared comments, I visited each individual/group and offered comments (1 hour); students continued adding text to their HTML documents—all of my individual conference time dealt with helping students to create HTML code as opposed to guiding students on the content of their chapters [2 hours]. Students were instructed to bring to class next time their supportive media (videos, pictures, audios, etc.).
10	The first hour was spent in demonstrating how to digitize various media: • scanning (15 min. demo]—8 students had no prior experience • video & audio digitization [30 min. demo]—11 students had no prior experience • digital camera demo [20 min.]—9 students had no prior experience The next 2 hours were spent in my assisting small groups of students in digitizing media.
11	The entire 3 hours were spent in my assisting small groups of students digitizing media [pictures, movies, tapes, etc.] and then altering the media digitally (e.g., teaching students the basics of PhotoShop to alter scanned in pictures). At the end of class, students exchanged their chapters with another; students were instructed to serve as a peer editor and bring the critique to the next class period.
12	This class session began with students sharing their peer editing comments; while students shared their comments, I visited each group and offered comments (1 hour); students spent the next hour integrating peer comments into their papers; during this time, I had conferences with individuals/small groups to check progress, offer feedback, or critique content. The last hour I helped individual students to debug HTML code (to fix anchor links, reformat pictures so that they would appear, correct hypertext links, etc.]. If students were making common HTML coding mistakes, I would interrupt students & offer my suggestions in a large group format.
13	The entire 3 hours were spent in my assisting small groups of students digitizing media and then altering the media digitally (e.g., teaching students the basics of PhotoShop to alter scanned pictures].
14	the entire 3 hours were spent in my assisting small groups of students to debug HTML code, digitize media, or alter the media.
15	For this session, 8 of the 12 students shared their final chapters with all other students during informal presentations (the actual chapter was projected onto a large screen in front of the class) (3 hours).
16	The rest (4) of the students shared their final chapters with all other students during informal presentations (2.0 hours); I provided a 30 min. course wrap-up by summarizing their achievements and offering my projections regarding future directions for authentic learning; course evaluations were taken (20 min.).